

kinds very special gifts are necessary. On the other hand, the developing of new sorts already on sale in limited quantities is much less difficult, and Mr. Malden shows that handsome profits may be made by those who are shrewd enough to recognise the coming varieties. Last year, for example, the kind known as "Northern Star" was selling at 10s. per lb.; this season the price was 5s. per lb., but it has now advanced to 15s. The tubers exhibited at the Smithfield show were priced at 7s. 6d. each! By growing plants from a single "eye" under garden conditions, the produce may be increased a hundredfold in one season. Thus Mr. Malden produced 168 plants and 418 lb. of tubers from 4 lb. of "setts" planted in the spring of 1902. At the present time, there are a number of first-class kinds awaiting development, and it is to be hoped that Mr. Malden's remarks may induce a larger number of farmers and gardeners to give attention to the subject. From the public standpoint, it is much to be desired that good new sorts should be rapidly multiplied and brought into the vegetable market.

A simple demonstration conveying a useful lesson to the farmer has just been carried out at the new Harper-Adams Agricultural College, Shropshire. Seven cwt. of an ordinary compound manure (a "special turnip manure" sold at 6l. 15s. per ton) was applied to an acre of roots; to a second acre, the same quantity of plant food was given in the form of a mixture of superphosphate and sulphate of ammonia, followed by a top-dressing of nitrate of soda. The cost of the special manure was 47s. per acre, of the other 27s. 9d. The result, as was anticipated, was an almost equal yield of roots, and a saving by using the home-mixed manure of 1l. per acre. This demonstration wants repeating in every county, for there are two classes who have not yet learned to assess "special" manures at their real value—manure manufacturers and farmers.

Under the suggestive title of "A new Departure in the Science of Fattening," Mr. Warington contributes a valuable paper to the *Agricultural Students' Gazette* (Cirencester). He discusses the recent work of Kellner on the feeding of farm animals, with special reference to the comparative effects of such fibrous fodders as hay and straw in the fattening of cattle. Agricultural chemists have held that the digestible nutrients in fodders of a similar character, such as oat and wheat straw, must have a similar value for the fattening animal, and they have argued that the comparative value must be shown by the composition. Practical agriculturists, on the other hand, hold that the chemical composition is not a correct index of the fodder's value, and they have never attached much weight to their scientific advisers' opinions of common farm foods.

The recent work of Zuntz (Berlin) and Kellner (Möckern) has shown that the farmer's opinion is correct and that a chemical analysis does not indicate the relative values of fodders grown under different conditions. The mechanical as well as the chemical composition has an important influence on the effects produced by a food on the fattening animal. A hard or tough straw requires more energy for its digestion than a softer one, this energy becomes a first charge upon the food, and thus the "efficiency" of an indigestible food is lower than that of a digestible one of the same chemical composition. It has, of course, been known that digestion involves an expenditure of energy, but Zuntz and Kellner have been the first to show how great the effect of this may be on the value of a fodder.

The former worker so long ago as 1896 wrote a paper for the *American Experiment Station Record* in which he discussed this question, pointing out that in the case of the horse the nutrients assimilated from hay yielded 20 per cent. less available energy than the same nutrients assimilated from grain; but the importance of Zuntz's work does not seem to have been appreciated in this country. Kellner's experiments are, however, likely to arouse widespread interest. He has compared the effects produced on fattening oxen by nutrients derived from various sources, and among other results he finds that to produce the same increase as is due to 100 lb. of starch it is necessary to supply 147 lb. digestible nutrients in meadow hay, 157 lb. in oat straw, and no less than 374 lb. in wheat straw. The figures, of course, hold good only for the particular samples of hay and straw used by Kellner; the importance of the result lies in the fact that a wide variation in value has been proved. Kellner's experiments may not, perhaps, affect the rations given by the farmer to his cattle, but they will very greatly affect the rations which he (the farmer) has hitherto been recommended to use.

The December number of the United States *Experiment Station Record* contains a short report of the sixteenth annual convention of the Association of American Agricultural Colleges and Experiment Stations. Among the papers read was one which emphasised the importance of breeding and selecting corn for different purposes, showing how much the market value might be affected by slight variations in the composition. The composition of the grain of cereals is a subject to which our English seed growers have hitherto given little attention. Wheat, for example, has been selected for appearance, for yield and for stiffness of straw, but the chemical composition has been neglected, with the result that the miller and baker condemn our present English wheats as inferior and unsuitable for flour-making. We grow about one-fourth only of what we consume, but so small is the proportion of home-grown wheat which millers can profitably mix with imported grain that the markets are often glutted with English wheat which millers will not buy. A very slight alteration in the chemical composition would enable millers to employ profitably 35 per cent. to 40 per cent. of English wheat in their mixtures, instead of 25 per cent. to 30 per cent. as at present, and would thus remove the possibility of glutting the market with English wheat. In ten or fifteen years time, we may hope to see this change in composition effected. In the meantime, it would be interesting to follow the lead of the American writer, trace the effect of composition on market value, and investigate the loss the nation has suffered in the past decade or two and must continue to suffer for years to come from this oversight on the part of our seed growers.

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WEST INDIAN NOTES.

THE third number of vol. iii. of the *West Indian Bulletin*, issued by the Imperial Agricultural Department, contains a large amount of information on a variety of subjects. Mr. Francis Watts deals with "Raw Sugars for Brewing Purposes," Mr. P. C. Cork with "Stock Rearing in Jamaica," Mr. Maxwell-Lefroy with "Scale Insects of the West Indies," &c. A lengthy account, 23 pages, of the volcanic eruptions in the West Indies includes a reproduction in full of a most interesting series of observations taken by the Rev. N. B. Watson, at his residence, about twelve miles east of Bridgetown, Barbados, from 5 a.m., October 14, to 6 a.m., October 17, covering the period of the Soufrière eruption in St. Vincent on October 15-16 and the dust fall in Barbados. Careful notes were taken of the direction and force of the wind, temperature, clouds, aspect of the sun, sky, the atmosphere, &c., and the rate at which the dust fell was frequently measured, the heaviest being 38.1 grammes per square foot, from noon to 1 p.m. on October 16.

The Department has also just published Nos. 19 and 20 of its pamphlet series, dealing with seedling and other canes at Barbados and in the Leeward Islands respectively. Of the large number of varieties of seedlings experimented with, the results for the past season show B. 208 to be the best all-round cane, beating all its rivals in Barbados, Antigua, St. Kitts and Trinidad. In Barbados, its juice was described as "exceedingly rich and pure," in Antigua as "exceptionally rich in sugar," and in St. Kitts as "of remarkable richness and purity." Part i. of the report on the sugar-cane experiments conducted at Antigua and St. Kitts in the season 1901-02, published at the same time, contains the complete statistical results for the two islands.

The report on the Antigua Botanic Station for the year ending March 31 last contains full particulars of the working of a "Peasant's Garden," in which nothing is done that cannot easily be accomplished by a working man having a similar small piece of land. In the previous year, the experimental plot was one-tenth of an acre; it required an expenditure, for labour, seeds and manure, of 1l. 15s. 3d., and the varied produce, when sold, fetched 2l. 15s., leaving a profit at the rate of nearly 10l. per acre. Last year the area was increased to one-seventh of an acre; the expenditure was 3l. 11s., and the produce realised 4l. 16s. 11d., showing a profit of about 9l. per acre. In re-afforestation experiments, about a dozen varieties of trees were being tested, the best growing being found to be mahogany and white cedar. It is curious that, while in neighbouring islands sugar-cane seedlings have been successfully raised, the several attempts made in Antigua have almost invariably turned out failures, very few fertile

seeds being, apparently, produced. Carefully selected arrows from different varieties have produced only about twenty germinating seeds, and of these only four seedlings have been saved and planted out. This is the total result of many trials in the island.

Reviewing agriculture in the West Indies in 1902, the official *Agricultural News* states that solid success attended the efforts to establish industries other than sugar in some localities, the progress made in onion cultivation standing out conspicuously. Both Antigua and Montserrat were able to export considerable quantities of onions, and Dominica and Barbados made satisfactory starts in cultivation. Cotton growing also showed substantial progress, a considerable acreage being under cultivation in Montserrat, St. Lucia and Antigua. At St. Lucia, cotton was grown on 105 acres last year, the whole southern seaboard, about forty-five square miles, being considered excellent soil for cotton, where it can be grown at about one-fourth of the cost of sugar-cane.

TECHNICAL EDUCATION AT HOME AND ABROAD.¹

A NATION'S view of the expected outcome of its system of education is frequently shown by the recurrence of a typical question. Thus a Frenchman, when considering a young man's qualifications, will naturally ask, What examinations has he passed? A German will ask, What does he know? An Englishman will inquire, What kind of a fellow is he? An American will ask, What can he do? These varied questions reflect the form of education in vogue. In them we see the French tendency to formalism, the German disposition to over-intellectualise their schools, the English love of all-around gentleman and the American fondness for achievement.

Since the close of the Franco-Prussian war, the development of Germany has been remarkable. Hamburg has risen from the sixth largest port in Europe to nearly the first; German cottons are sold in Manchester, German steel in Sheffield and Leeds, German silks in Paris, and "Made in Germany" is a familiar mark to us. From 1875 to 1895, the population increased from 45,730,000 to 52,250,000. The working energy, during the same period, increased from twenty-five to more than forty-six million foot pounds daily, or about four times as fast as the population. Between 1889 and 1896, the exports from Germany to China increased 86 per cent.; to Japan 92 per cent. The tonnage of German vessels trading with these countries has trebled since 1886. The number of German steamers in 1871 was one hundred and fifty; in 1897 this number had increased to eleven hundred and twenty-five. During the same period, the tonnage increased from 82,000 to 900,000. That Germany has been successful in a commercial way during the past thirty years is not to be denied. Her success can be traced to her belief in the industrial value of scientific research and to her fostering care of the technical education of her people.

From an examination of special industries, we can obtain a clearer idea of this influence. Consider the beet sugar industry. In 1840, 154 000 tons of beets were treated, yielding 8000 tons, or 5½ per cent. of raw sugar. In 1899, with improved scientific processes, 12,000,000 tons were crushed, yielding 1,500,000 tons, or 13 per cent. of raw sugar. This increase of yield from 5½ to 13 per cent. is the direct result of the work of technical men in control of the industry. Not only is Germany no longer dependent upon the West Indies for her sugar, but in one year she has sold Great Britain fifty million dollars worth. The manufacture of alcohol from potatoes is another lucrative field for German technologists. The cost has been reduced to about 25 cents per gallon, and experiments are in progress to determine its efficiency as fuel on steamers. The manufacture of artificial indigo by a chemical process was discovered in Germany in 1866. Less than forty workmen were then employed; now more than six thousand men and a staff of one hundred and forty-eight scientific chemists are employed in the industry. The natural indigo is almost driven out of the market. They have also discovered a method for obtaining from steel processes ground slag which is used as a fertiliser; and England, although she produces quite as much steel as Germany, has become a good customer for the article. Recently there came the dis-

covery, by a chemist, named Giebler, of a process of hardening steel which makes it, it is said, 14 per cent. stronger, 50 per cent. lighter and one-third less costly than the Krupp or Harvey steel. Twenty-five years ago, the English and French makers of scientific instruments of precision were far in advance of the German. However, through the organisation of the Reichsanstalt, an institution for original research and the standardising of instruments, supported by the Government, Germany has become the manufacturer of the best scientific instruments in the world. The value of her exports in this line is nearly 2,000,000 dollars, three times what it was fifteen years ago, and the work gives employment to 15,000 people.

The Germans are fully alive to the necessity of being well prepared to engage in the struggle for industrial supremacy. Prince Bismarck once said: "The war of the future is the economic war, the struggle for existence on a large scale. Maymy successors always bear this in mind and take care that when the struggle comes we are prepared for it." Bismarck's behest has been heeded. The Germans, by dint of long and thorough preparation, are ready for an economic war. For more than thirty years they have been preparing, and we can see in all directions the steps that have been taken to improve the technical sides of education, so as to produce men who are capable of carrying Germany to the front in this industrial and commercial struggle. The system of German technical schools comprises first a group of *Technischen Hochschulen*, situated at the capitals of the German States, like those of Berlin, Dresden, Munich and Carlsruhe. These are of the very highest grade, admitting only students who have completed a *Gymnasium* or *Realschule* course of study. They have without exception developed gradually from mere trade or building schools. Most of them were founded in the twenties and thirties of last century, and one—the Charlottenburg—was founded as early as 1799. These schools are all beautifully housed, have superb equipments, and are doing a high grade of professional engineering work. Next below them in educational rank comes a great number of trade schools, like the Textile School of Crefeld. These trade schools are located at the centre of the industry to be benefited and are distinctly utilitarian in character. Besides these, there are many continuation and manual training schools. So numerous are these specialised schools that a German can always find one in which he can learn the latest and best principles, devices and methods of any trade or profession he may desire to follow. Add to all these the latest German innovation of commercial high schools and colleges of commerce, then wonder, if you can, why German competition is so keen and why German trade and industry are reaching every market the world over. The Germans have discovered that the secret of success in trade and industry depends upon education; not upon the education of the library and cloister, but upon the education of the laboratory, the shop and the modern lecture room.

Contrast with this the condition of England.

In 1870, Great Britain, exclusive of her colonies, did one-quarter of the world's business, and, including her colonies, 35 per cent. In 1895, her share had fallen to 18 per cent., or, including her colonies, to 31 per cent., showing that while she still held the lion's share, that share was steadily diminishing. From another point of view, a similar tendency can be seen. Between 1870 and 1895, British exports increased only 13 per cent., while during the same period the exports of Russia increased 17 per cent., of France 20 per cent., of Germany 42 per cent., and of the United States 110 per cent., showing that England's commercial advancement during this period was relatively the least of all.

American tools and labour-saving devices are rapidly entering British workshops. One firm recently expended 100,000 dollars in new machinery, two-thirds of which was of American make. In other branches of manufacture, the American and Continental engineers have succeeded in introducing into England many articles which the English imagined, but a short time ago, could not be made cheaper or better than in Great Britain, like electrical machinery, locomotives, steel rails, sugar-producing machinery, and even stationary engines, the pride of the British engineering industry. The year 1901 was noteworthy in that the output of steel in Great Britain fell behind that of the United States by 5,000,000 tons and behind that of Germany by more than a million tons. The machine tool trade is also fast becoming Americanised. In agricultural machinery, the United States is outstripping England with giant strides. In gas machinery, Continental orders are seldom

¹ Abridged from a paper on the need of technical education, by Prof. Victor C. Alderson, Dean of the Armour Institute of Technology, read before the Chicago Literary Club, October 20, 1902.